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ABSTRACT

This literature review examines a hypermedia learning environment from a semantic network basis and the application of such an environment to second language learning. (A semantic network is defined as a conceptual representation of knowledge in human memory). The discussion is organized under the following headings and subheadings: (1) Advantages and Limitations of Hypermedia--nonlinearness, associativity, flexibility, efficiency, disorientation, cognitive overhead, and learner control; (2) Theoretical Assumptions of a Semantic-Network-Based Hypermedia Learning Environment--John Dewey's philosophy, Norman's Mental Model Theory, Craik and Lockhart's Levels of Processing Theory, and Rumelhart and Norman's Modes of Learning Theory; (3) Hypermedia and Semantic Networks; and (4) Semantic-Network-Based Learning Environment and Second Language Learning--Communicative Computer Assisted Language Learning (CALL) and Communicative CALL and Hypermedia Assisted Instruction. It is concluded that a semantic-network-based hypermedia learning environment, grounded in levels of processing theory and modes of learning theory, seems to be particularly appropriate for second language learning, as it provides not only a vivid and natural environment for the accumulation of the facts of a second/foreign language, but also tools to synthesize and integrate the new knowledge, and reconstruct the existing knowledge. Two tables and three figures are included. (Contains 38 references.) (ALF)

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Hypermedia-Assisted Instruction and Second Language Learning: A Semantic-Network-Based Approach

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Introduction

Let us consider a scene (as adapted) Duchastel (1990) has described in his article "Discussion: Formal and Informal Learning with Hypermedia": You are viewing the evening news on television about Chinese imperial dynasties. A news item about a recent archaeological finding in Kiangsu province has aroused your curiosity. You interrupt the newscast momentarily to get further information. By touching the words "Chinese" and "dynasties" on the TV screen, you are led to an overview given in the form of a graphical representation of the Hypermedia information bank. You begin to explore information related to this news item. Since the information items in this Hypermedia bank are related to each other, a touch on the screen will branch you to various topics in which you are interested. Some information presented is textual, some graphical, some video, and other in map forms. Your exploration continues until your curiosity is satisfied. Then you resume watching the evening news at the point where you left off, which is now a video-recording.

What is described here is an example of Hypermedia. Compared with print materials that we are so accustomed to, accessing information in this situation is different in a number of ways. It not only involves the textual information but also information in the form of graphics, sound, and video. These multimedia information elements are interconnected and are presented in such a way that a touch on the screen will bring the relevant materials to a user. There is no particular linear sequence of accessing the information imposed upon a user. The process of exploring is interactive, nonlinear, user-controlled, and often determined by a user's interest and curiosity. These characteristics of Hypermedia technology have provided a new way to present and organize information.

Hypermedia, first conceived by Vannevar Bush in 1945, is a new form of computer technology being popularized and technologically made possible during the recent few years. It refers to an associative, nonlinear information presentation and representation system built around a network of multimedia materials such as text, graphics, sound, and motion (Conklin, 1987;

Hammond, 1989; Heller, 1990; Jonassen, 1989). Applying Hypermedia techniques to teaching and educational software development is sometimes called Hypermedia-Assisted-Instruction (HAI) (Heller). In the past two or three years, we have seen a growing interest in Hypermedia technology. There is a growing literature on Hypermedia's educational relevance because the technology of Hypermedia has provided breakthroughs to the traditional methods of learning and teaching. Attempts have been made to integrate this technology in different disciplines. Research examining the impact of Hypermedia technology upon learning and teaching is beginning to emerge. This paper examines a Hypermedia learning environment from a semantic network basis and the application of such an environment to second language learning (learning a language by non-native speakers for the purpose of communication).

Advantages and Limitations of Hypermedia

As a tool for learning and teaching, Hypermedia has both advantages and limitations. Consideration of these attributes is a necessary background to discussion of a semantic-network-based Hypermedia learning environment. The following is an overview of some of the well-documented advantages and limitations of Hypermedia technology.

Advantages of Hypermedia

Nonlinearness. Unlike printed materials, there is no specific sequence of proceeding from one point to another in a Hypermedia environment. There are no obvious beginning or ending points. Learners can choose different ways to pursue the subject matter based upon their own interests and objectives. This nonlinear environment can better accommodate individuals' different needs and different learning styles and is more suitable for discovery learning. As Mayes, Kibby, and Anderson (1990) pointed out, "By requiring learners to move towards nonlinear thinking, they may also stimulate processes of integration and contextualization in a way not achievable by linear presentation techniques" (p. 229).

Associativity. Hypermedia mirrors some of the functions of human memory in that logically and semantically related information can be linked together to form a network. It is not only a tool suitable and capable of representing the knowledge base of an expert on a subject but also a tool that can enable learners to construct their own knowledge bases by making meaningful connections among the ideas as they perceive (Conklin, 1987; Dede & Palumbo, 1991; Hammond, 1989; Heller, 1990; Jonassen, 1989; Marchionini, 1988).

Flexibility. The flexibility of Hypermedia is multi-fold. From the learner's point of view, he or she can follow the subject matter semantically but not necessarily physically from one page to the next. There is no arbitrary order imposed upon a learner as to how to proceed. The learner can jump freely from one idea to another without worrying if it is the right sequence or what sequence to follow. Learners can simply let their interests guide them. From a systems point of view, Hypermedia is capable of revealing and concealing the complexity of a subject matter more easily than the linear method. The content of a subject matter can be presented with different levels of complexity. At each level, the system can let the learner be aware of the next level of content, but the learner need not activate it, if not interested. Therefore, the complexity of a subject can be concealed until the user asks for it. This can not only lessen the cognitive load on a learner, to some extent, but can also help the learner assimilate and accommodate ideas. Finally, from the designer's point of view, the designer can easily modify the information in specific nodes without affecting the entire system, since the information in a Hypermedia system is modular in nature (Conklin, 1987; Dede & Palumbo, 1991; Hammond, 1989; Heller, 1990; Jonassen, 1989; Marchionini, 1988).

Efficiency. In a Hypermedia environment, different forms of information such as text, graphics, animation, and sound can all be brought to the screen simultaneously. By a simple touch on the screen, a keypress, or a mouseclick, the user can activate a link from a node of text to a node of graphics or a combination. This is much easier and faster than juggling

encyclopedias, a videoplayer, a cassette player, and an atlas at the same time (Conklin, 1987; Dede & Palumbo, 1991; Hammond, 1989; Heller, 1990; Jonassen, 1989).

Limitations of Hypermedia

Disorientation. One of the most obvious disadvantages of Hypermedia is that users can easily become disoriented (lost) in the hyperspace. Unlike reading a book in which one usually knows exactly how many pages have been read and how many more are expected, one can easily lose sense of location in a nonlinear environment. There are no obvious beginning and ending points, especially when navigating through a large Hypermedia system containing hundreds or thousands of nodes and links (Conklin, 1987; Dede & Palumbo, 1991; Hammond, 1989; Heller, 1990; Jonassen, 1989; Marchionini, 1988).

Cognitive overhead. As a new way of learning, Hypermedia imposes additional cognitive overhead upon a user as he or she tries to keep track of links, makes decision about how to proceed, and possibly creates new nodes herself. "The richness of a nonlinear representation carries a risk of potential intellectual indigestion, loss of goal directedness, and cognitive entropy" (Dede & Palumbo, 1990, p.8). Using a Hypermedia system requires a new type of literacy (i.e., Hypermedia literacy) to handle such an environment effectively. Novice users often feel uncomfortable with such systems; and, as a result, the environment is less beneficial. Therefore, creating Hypermedia systems involves a very large front-end investment of time and expertise (Jonassen, 1989).

Learner control. As an instructional strategy, learner control suggests that instruction will be more motivating and meaningful if the learner is given control of instructional decisions. Because of its highly interactive nature, a Hypermedia environment places a large amount of responsibility upon the learner. However, research shows that not all learners can benefit from this less structured learning environment. Some actually produce less satisfactory results (Jonassen, 1989). As such, the characteristics of learner control in Hypermedia seem both a blessing and a curse.

Theoretical Assumptions of a Semantic-Network-Based Hypermedia learning Environment

Rationale

From John Dewey's Educational Philosophy. One of the key points of John Dewey's philosophy for curriculum development is that one learns through experiences and meaningful interaction with the environment and other people (Dewey, 1966). Therefore, in order for learning to occur, schools and society must provide these meaningful experiences to learners. Learning takes place when one organizes and reorganizes, constructs and reconstructs one's experiences. The role of schools is to provide a proper environment where learners have the opportunities to fully realize their potentials. The role of a teacher is to provide proper guidance and direction for learners to exercise their judgments and decisions and to reach their goals. Dewey said that "the educational process is one of continual reorganizing, reconstructing, transforming" (p. 50). A semantic-network-based Hypermedia learning environment where related ideas are linked to form a network of information is capable of providing meaningful experiences to a learner. Each information element in this network contributes in its own way to a better understanding of the subject. With the interrelatedness among ideas in such a network, learners are given an opportunity to view a subject from different perspectives in a multi-dimensional way.

From Norman's Mental Model Theory. While interacting with the environment and with others, people often form internal mental models of themselves and of the things with which they are interacting (Norman, 1983). The purpose of these mental models is to enable human beings to understand the subject matter or the object of their interaction, that is, to understand what they are learning. According to Norman, human beings' mental models are usually deficient in that they are incomplete, unstable, unscientific, and parsimonious. They are unstable in that people often forget things, especially the details. They are unscientific because people often have their own ways to proceed with an action. Especially after having encountered some difficulties and experienced the outcomes, they have formed certain beliefs as to how a

particular sequence of actions will reduce or eliminate the difficulty. For example, some people, in working with computers always go back to the main menu before proceeding to the next option, even though they can go directly from one option to another. The mental models can also be parsimonious as people are often reluctant to make mental efforts which would allow them to avoid performing extra physical operations.

The study of human mental models has the following implications in terms of learning new knowledge. First, because people's mental models are often incomplete, we must provide knowledge to learners in order to help them develop more coherent and usable mental models. Second, we cannot expect learners to remember everything they have learned. Learners need some kind of tools that can provide the overall structure of a new subject as well as its elaborative details. Third, it is the duty of educators to help learners develop more adequate, appropriate, and complete mental models through tools that can enable learners to see the interrelationships between the topics and subtopics. Fourth, because learners' mental models are often "unscientific," it is necessary to present, to a learner, more scientific mental models, rules, and techniques that have already been proven in order for them to learn more efficiently.

A semantic-network-based Hypermedia learning environment, with its emphasis on the interrelationship among ideas, takes full advantage of the nonlinearity, associativity, flexibility, and efficiency characteristics of Hypermedia technology and appears to be capable of providing a more coherent and complete mental model.

From Craik and Lockhart's Levels of Processing Theory. Many psychologists classify memory into three levels of storage, sensory store, short-term memory, and long-term memory (Craik & Lockhart, 1972). All information we receive through vision, hearing, or other senses goes directly to sensory store. Information only stays there in the form that it is received for a second or two, and then it is lost. The short-term memory, also called working memory by some, holds information considerably longer and is not necessarily in its original form. However, information in the short-term memory is not remembered in any permanent sense with only a

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limited number of items being kept at any one time. The amount of information that the short-term memory can hold at one time is about seven chunks or items (Miller, 1956). Long-term memory is the highest level of the memory storage. Its capacity is unlimited; and, theoretically, nothing stored there will be lost.

Craik and Lockhart's theory of levels of processing has much to do with the differences between short-term and long-term memory. According to this theory, information received is processed at different levels (Craik & Lockhart, 1972). Information such as brightness, pitch, and loudness is processed at the preliminary stage of sensory analyses, whereas other information is processed through a deeper process such as pattern recognition, stimulus elaboration, and meaning extraction. Information in short-term memory is usually phonemic and visual in format; information in the long-term memory, which needs to be processed at a deeper level in order to be retained, is largely semantic. The more familiar and meaningful the stimuli, the deeper the level of processing, and the better and longer the information will be retained. Craik and Lockhart said that retention is a function of depth, not speed. In fact, it usually takes more time in order for information to be processed at a deeper level.

According to Craik and Lockhart (1972), in order to have longer retention, information not only needs to be repeated but, more importantly, needs to be organized in a meaningful way (i.e., processed at a deeper level). If a word is presented only with its phonemic features, it probably will mean nothing to a learner and will quickly be forgotten. However, if this word triggers some associations from a learner with the past experience, the word is more likely to be remembered. In teaching the word "apple" to a child, for example, instead of just showing her the word and reading the word aloud to her, the word "apple" can be shown along with the features of a real apple, its shape, its color, and its taste. The child is more likely to remember the word this way because this multidimensional approach can build meaningful associations in memory. The look, the feel, and the taste of an apple helps a child remember and understand the concept of an apple. This is known as the "depth of processing." The deeper the level at which the information is

processed, the greater the degree of semantic or cognitive analysis, and the longer one retains that information.

From Rumelhart and Norman's Modes of Learning Theory. The second theory supporting the semantic-network-based Hypermedia learning environment is Rumelhart and Norman's modes of learning theory (Norman, 1978; Rumelhart & Norman, 1978). According to this theory, there are three basic modes of learning: accretion, restructuring, and tuning. Accretion is a straightforward addition of knowledge to the existing KMs[1]. At the stage of accretion, one is simply adding new information to the existing knowledge without modifying the existing knowledge structure (i.e., accumulating knowledge). Accretion occurs through appropriate exposure to the concepts and facts to be learned. Accretion is important and necessary in order to establish a database upon which appropriate knowledge structures can be formed through restructuring. Accretion learning requires study and possibly deep levels of processing. When newly acquired information does not fit the current available memory structure, the existing knowledge structure is reorganized, and, in some cases, a new knowledge structure is created for interpreting new information. This is the stage of restructuring. At this stage, learners are expected to say "oh" and "aha" and have some jumps in understanding. Norman (1978) said that "if accretion is knowledge acquisition, restructuring is knowledge understanding" (p. 41). Because restructuring involves possible change of the existing knowledge, it takes place only after considerable time and effort. Tuning involves continuing modification of the existing knowledge so as to improve the accuracy, generalizability, and specificity of the existing knowledge (Rumelhart & Norman, 1978). Though making improvements, tuning does not change the existing knowledge structure. At the stage of tuning, the performance of a task becomes smoother, more efficient, less hesitant, and automatic. In order to reach the stage of tuning, one needs to practice and do problem-solving, that is, to use the knowledge repeatedly. Therefore, tuning can be a lifetime task.

According to this theory, these three modes of learning do not necessarily occur in sequence. They can sometimes happen simultaneously. For example, in the process of learning, one first acquires knowledge (facts and concepts). During the process of knowledge accumulation (accretion), restructuring can occur along with accretion in that learners organize and reorganize their knowledge structures and create new structures. Tuning could also accompany accretion and restructuring. However, over the entire course of learning a subject, there will be stages when one mode of learning is a dominant form.

Both theories, the theory of levels of processing and the theory of modes of learning, center on the point that learning goes through different stages. In order to learn more effectively, new information must be integrated into the existing knowledge structure, and old information should be reorganized to accommodate new information. Learning is connecting, and humans are good learners because they can make many connections. But what can be used to help make meaningful connections between what is intended and what is actually learned? How can we represent closely what is in our mind? Craik and Lockhart (1972) stated that the information in long-term memory was largely semantic. In order to retain information in a more permanent sense, one must study the underlying structure of the information — the semantic information. Semantic networking is one of the tools which allows us to do that.

Hypermedia and Semantic Networks

Because of its capability of representing the mental process within human memory, semantic network is one of the most popular formats used to represent the information in human minds. A semantic network is a conceptual representation of knowledge in human memory (Jonassen, 1990; Norman, 1976a; Norman, Gentner, & Stevens, 1976). It is characterized by a network structure of nodes and links and is often displayed by a directed graph in which concepts are represented as nodes and relationships between concepts are represented as links (Conklin, 1987). The theory of semantic networks states that (a) human memory is associative in nature, and

ideas and information in memory are interrelated with each other; (b) this interrelatedness among ideas can be depicted by nodes and labelled links that connect nodes and can be represented by some precise and formal structures (Anderson & Bower, 1973; Lindsay & Norman, 1972; Norman, Rumelhart, and LNR Research Group, 1975). Because of its networking nature, a semantic network is capable of depicting and representing the "mess" of association in human memory. Hypermedia, using the same terminology of nodes and links, is a computerized way of representing the semantic network in human memory. Like human memory, concepts and ideas in Hypermedia do not exist in isolation, but rather in association with other concepts and ideas. They are often packaged into nodes, whether they are cards, windows, or files; these nodes are, in turn, connected with and among each other through links, which can be referential, organizational, or keyword links (Conklin, 1987). This computerized information network structure is a better means of representing the complexity of the human mind. Through a Hypermedia system, this complexity can be revealed or concealed in that there can be many layers of information interwoven with each other, and yet only the most basic concepts of a subject are displayed at first. Upon a user's request, the elaboration on the subject can be provided. A user has the choice not to see certain detailed information if he or she does not want to, while still being aware of its existence. Thus, a more complete and adequate human mental model can be represented efficiently. Just as it is stored in human memory, information in a Hypermedia system is nonlinear in nature. Because of the closeness between Hypermedia and human memory, the analogy between them is direct. Nodes in a Hypermedia system are like concepts (or schemata) in a semantic network of human memory; links are like the semantic interdependence among these concepts. The process of building a Hypermedia network is a kind of knowledge engineering (Conklin; Jonassen, 1989). Hypermedia technology has provided a tool to help depict and display what occurs in human memory.

A semantic-network-based Hypermedia learning environment is a Hypermedia learning environment grounded in the theory of semantic-networks. Such an environment will not only display the interrelatedness of concepts through making full use of links, explicit or implicit, but

will also emphasize the semantic relationships among the concepts. That is, in a semantic-network-based Hypermedia, concepts are related through their semantic content rather than some arbitrary order, such as alphabetizing. Therefore, it is natural to use Hypermedia to represent the semantic network of human memory. The technology of Hypermedia makes the input of information more natural and direct, the display of information more active and realistic, the representation of information richer and more detailed, and the construction of information more flexible and efficient.

Semantic-Network-Based Hypermedia Learning Environment and Second Language Learning

The linking and networking among multimedia materials has given Hypermedia the power to provide an alternative to the traditional and print-based learning and teaching. Currently, the power of Hypermedia has been tested in many different subject areas. One of the areas that Hypermedia can find a ready place is second language learning. In the following, I have examined the technology of Hypermedia and second language learning from two perspectives: (a) a linguistic background for Hypermedia-Assisted-Instruction and (b) a semantic-network-based Hypermedia learning environment for second language learning.

Linguistic Background for Hypermedia-Assisted-Instruction

Communicative CALL. Computer Assisted Language Learning is often termed as CALL. CALL has proven effective in second language learning and teaching (Chapelle & Jamieson, 1986; Hope, 1982; Jones, 1986; Morgan, 1986; Taylor, 1979). The use of CALL has been experiencing changes from focusing on drill-and-practice and tutorial to the possibility of using computers to teach communicative skills (Schaeffer, 1981). One of the purposes of promoting communicative CALL is to incorporate grammatical and lexical items into the context with which a learner is to interact during the process of learning. The linguistic background for communicative CALL is the teaching strategy of the communicative approach.

The basis of such an approach to language learning and teaching is the theory of communicative competence which states that a speaker's knowledge of language includes four aspects with regard to a linguistic utterance: (a) whether the utterance is formally possible; (b) whether it is feasible by virtue of the means of implementation available (c) whether it is appropriate in the context; and (d) whether and how it is actually performed (Hymes, 1971). To apply this theory to language teaching, Widdowson (1981) suggested that what should be taught in the classroom was the use of a language, that is, how a learner can communicate properly in different situations. A proficient language user should be one who not only has the adequate knowledge of all aspects of the language but also is able to use the language *appropriately* and *correctly* in different situations.

Communicative CALL is also based upon the assumption of second language acquisition theory (L2 acquisition). Krashen (1982) discussed five factors in second language learning/acquisition, of which input and affective filter factors relate directly to the present discussion. The basic important principle based upon these factors states that in order to acquire a language, two conditions are necessary: comprehensible input must be available to the learner, and a low affective filter should allow input in. A low affective filter refers to low anxiety, high motivation, and greater confidence which, according to Krashen, are the conditions for success in acquiring a non-native language. The implications of this principle suggest that learners should have the opportunity to comprehend language before they are asked to produce it, shifting the emphasis from output to input. In order that the input be meaningful, it needs to be comprehensible. In order that input be meaningful, comprehensible, and challenging, it must appear in a meaningful context and in quantity. The implications of the L2 acquisition theory for CALL are not drill-and-practice of discrete grammatical structures or vocabulary learning in isolation but, rather, the integration of language elements in meaningful context for real purposes.

Based upon this theory, different ways of teaching communicative skills have been suggested and implemented such as using simulations and games, word-processing, and electronic

mail. The potential of Hypermedia technology also seems to be appropriate for promoting communicative CALL.

Communicative CALL and Hypermedia-Assisted-Instruction. Underwood (1984) has discussed the premises for communicative and noncommunicative CALL in his book *Linguistics, Computers and the Language Teacher: A Communicative Approach.* Table 1 and Table 2 explain the comparison of these features with the characteristics of Hypermedia. It seems that the capabilities of Hypermedia could match each of the communicative CALL parameters. Research has shown that an optimal language learning environment is crucial to any successful language learning and teaching. Teaching methods such as stressing the role of context and providing realistic environments for language learning are often used to help learners acquire effective communicative skills (Bransford, Sherwood, & Hasselbring, 1988; Omaggio, 1986; Walker de Felix, Johnson, & Schick, 1990). A Hypermedia-based CALL can make good use of graphics, text, sound, and animation, so as to present a target language as naturally as possible in "real" and varied communicative situations. By immersing students in the "natural" and enriched environment created by the computer, students are exposed to the target language with high frequency and efficiency. Moreover, because a Hypermedia-Assisted-Instruction is capable of meeting learners with different needs and varying abilities, such instruction should be highly motivating and stimulating. Therefore, the technology of Hypermedia should be a good tool for promoting learners' communicative skills.

Semantic-Network-Based Hypermedia Learning Environment for Second Language Learning

From the memory structure theory and levels of processing theory, we know that information stored in short-term memory is likely to be lost whereas information in long-term memory, usually processed at a deeper level, will be retained. Semantic network theory tells us that information in memory exists in an interconnected network. To process information at a deeper level often requires building connections between the new piece of information and the existing network of information. In learning a concept, establishing semantic ties between this new

concept with existing ones can promote understanding and retention of a concept. The more semantic ties this new concept has with the existing concepts, the more stable it will become. If this new concept only has one or two ties with others, it is likely to swing around and become disconnected; whereas, if it has many semantic ties with others, its movement within a semantic network is confined and therefore very stable (Davidian, 1982). The more stable the concept, the firmer the relationship this concept has with the existing network of information, and the more meaningful and better integrated this concept becomes (See Figure 1). Such concepts are then likely to be retained. Semantic-network-based Hypermedia provides a computerized technology to facilitate this integration of new information to the existing knowledge structure in human memory.

Insert Figure 1 about here

Second language learning, like a child learning his or her mother tongue, is a continuous and lifelong process of being exposed to various aspects of the target language (Brown, 1987; Foelsche, 1990; Omaggio). In a semantic-network-based Hypermedia learning environment for second language learning, the integration of knowledge is assisted, on the one hand, by the multimedia materials to provide a multidimensional perspective of the target language. Listening, speaking, reading, and writing — four equally critical skills to a second language learner — are all emphasized and can be integrated through sound, graphics, texts, and video. That is, in such an environment, learners are presented with a holistic picture of the target language. On the other hand, for an adult learner language learning is often a conscious and goal-directed process of participating, interacting, imitating, and synthesizing. The emphasis on the interrelatedness among concepts in a semantic-network-based Hypermedia learning environment and the high level interaction between learners and computers provides a much more meaningful context for learning. Take learning vocabulary, for example. In a semantic-network-based Hypermedia learning environment, a learner can be flooded (immersed)[2] in an enriched multidimensional cultural

context, connecting history, geography, art, cultural customs, and social factors of a target country with the linguistic aspects of the target language. The words to be learned are no longer isolated by themselves, but, instead, are meaningfully linked to a much larger context. While flooding learners in a target language, different linguistic features of a word can be more easily focused (conscious learning) through a semantic network. Features such as the definition, pronunciation, parts-of-speech, and synonyms and antonyms of a word can be brought together in a networking structure and studied in relation with other words (see Figure 2).

Insert Figure 2 about here

Focusing is objective when all the important aspects of a word are mapped out efficiently through a networking structure to assist learning, and focusing is, at the same time, subjective when a learner is motivated by the high level interaction and multimedia materials of the Hypermedia technology. This approach of providing a much broader view of the language while enabling a learner to focus on particular linguistic items, is more comprehensible and significant for the purpose of communication, as not only the pronunciation, intonation, and syntax come into play, but also and perhaps more importantly the meaning. The retention of words learned in such an environment should be high, as the semantic ties with the existing knowledge are strong and stable. The transfer of proper word use to other situations should occur more likely, as learners are embedded in a "realistic" communicative situation made possible only through computer technology. Therefore, such a learning environment should promote deep processing of information and thus facilitate language learning. In short, the integration of Hypermedia-Assisted-Instruction into second language learning (vocabulary learning in particular), based upon levels of processing theory and modes of learning theory, can be summarized as follows (Figure 3).

Insert Figure 3 about here

Conclusion

The multimedia capabilities, the high level interactivity, and the power of association have aroused much excitement about the technology of Hypermedia. Its parallel features to those of the human memory system are especially attractive. A semantic-network-based Hypermedia learning environment, grounded in levels of processing theory and modes of learning theory, seems to be particularly appropriate for second language learning, as it provides not only a vivid and natural environment for the accumulation of the facts of a second/foreign language but also tools to synthesize and integrate the new knowledge, and reconstruct the existing knowledge. As a new tool for learning and teaching, the potential of Hypermedia is being explored, and its promises are yet to be fully realized.

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Footnotes

[1] KMs refers to knowledge modules, Norman's term for memory structure.

[2] Davidian (1982) has proposed the concepts of flooding and focusing for second language learning. Flooding, according to Davidian, is to lay a broad pre-operational semantic base by immersing learners in language. Focusing is to give necessary concentration to the learning.

Table 1

Linguistic parameters for noncommunicative and communicative CALL

Linguistic Parameters
Noncommunicative CALL
• Program incorporates grammatical sequencing
• Program judges to inform students of their errors
• Program is in control
• Subject matter is irrelevant to student
• Lesson is predetermined
• Student perceives task as a required lesson
• Student views task as identical to classroom activities
Communicative CALL
• Program does not impose grammatical sequencing
• Program judges more to provide helpful hints
• Student is in control
• Student relates to subject matter in a personal way
• Student creates own learning experience
• Student perceives task as motivating supplement
• Student views task as a novel activity

Note. Underwood's premises presented here are based upon a summary by Chapelle (1990, p.202)

Table 2

Parallel features between communicative CALL and Hypermedia

Communicative CALL	Hypermedia
• Program does not impose grammatical sequencing	• nonsequential and nonlinear
• Program judges more to provide helpful hints	• contextual
• Student is in control	• high level of learner control
• Student relates to subject matter in a personal way	• learners can construct their own knowledge structure
• Student creates own learning experience	• better accommodate learners with different styles
• Student perceives task as motivating supplement	• multimedia aspect is a source for motivation
• Student views task as a novel activity	• provide new experience

Figure Caption

Figure 1. An illustration of knowledge acquisition in a semantic-network context. This figure is based upon Norman's illustration of *network representation of the knowledge structure in memory*. (Norman, D. A., 1976b, *Studies of learning and self-contained educational systems*.)

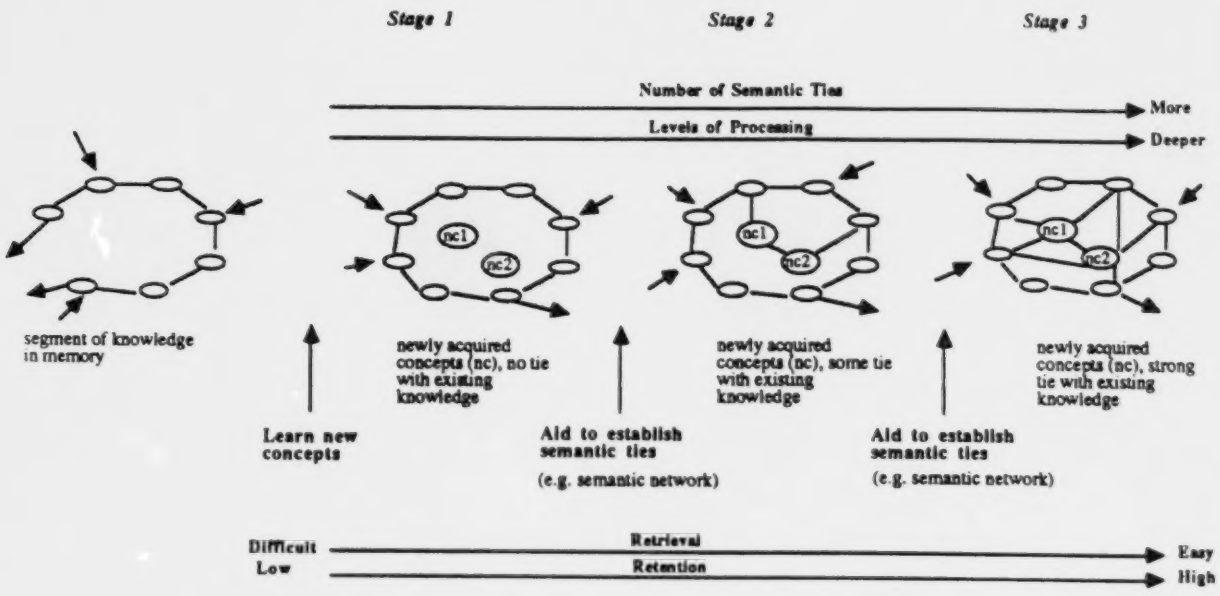

Stage 1
Stage 2
Stage 3
Number of Semantic Ties
More
Levels of Processing
Deeper
nc1
nc2
segment of knowledge in memory
newly acquired concepts (nc), no tie with existing knowledge
newly acquired concepts (nc), some tie with existing knowledge
newly acquired concepts (nc), strong tie with existing knowledge
Learn new concepts
Aid to establish semantic ties
(e.g. semantic network)
Aid to establish semantic ties
(e.g. semantic network)
Difficult
Retrieval
Easy
Low
Retention
High

Figure Caption

Figure 2. Flooding in larger cultural context while focusing on specific linguistics items (R= relationship, W = word).

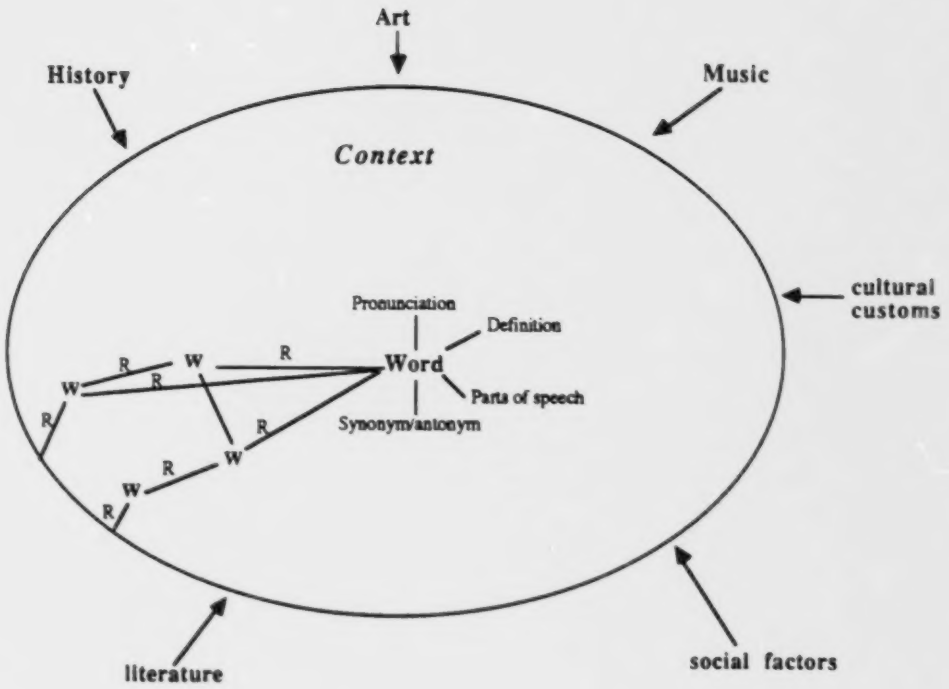
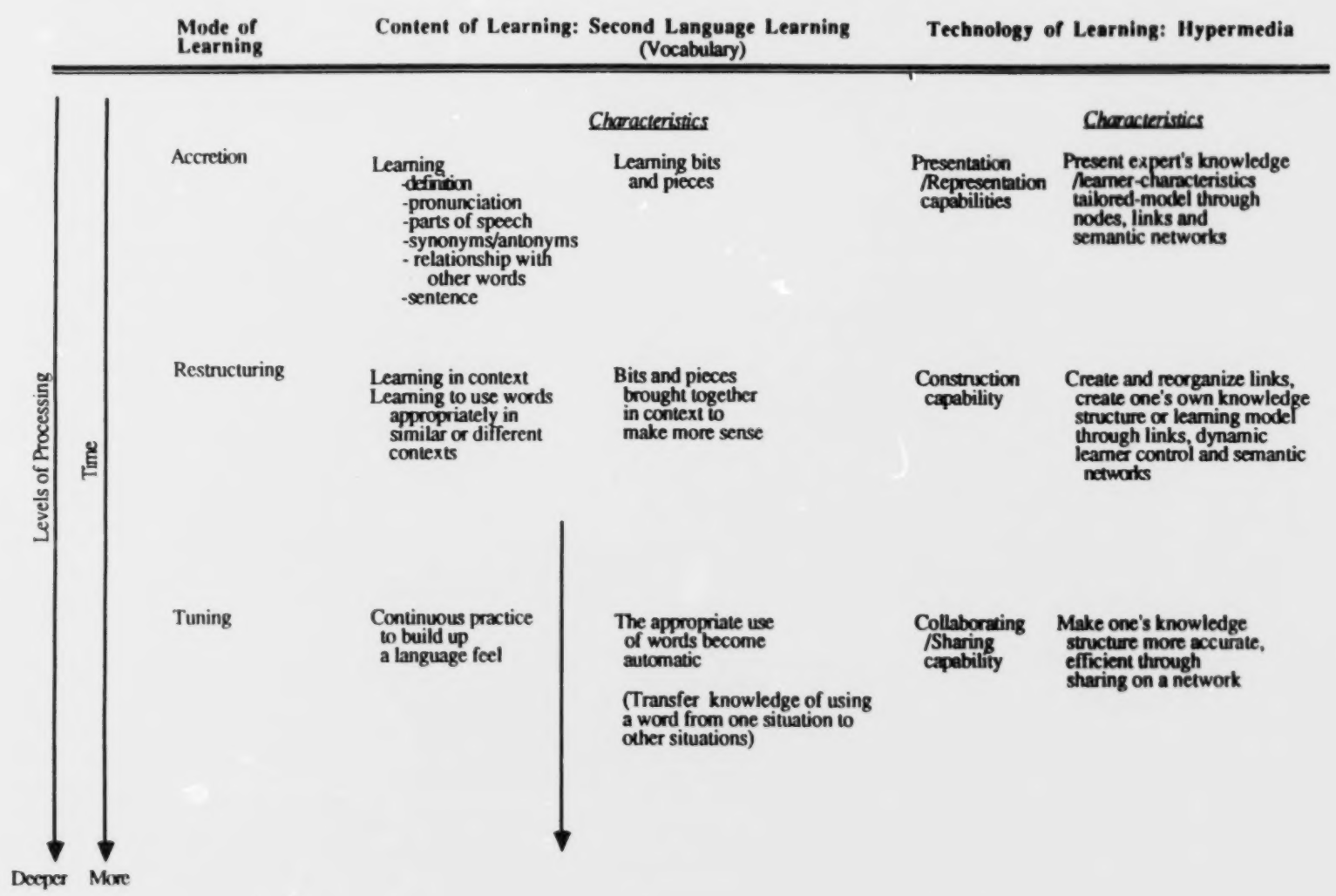

Art
History
Music
Context
cultural customs
Pronunciation
Definition
Word
Parts of speech
Synonym/antonym
R
W
literature
social factors

Figure Caption

Figure 3. Integrating Hypermedia-Assisted-Instruction into vocabulary learning, based upon levels of processing theory by F. I. M. Craik, R. S. Lockhart, 1972, and modes (accretion, restructuring and tuning) of learning theory by D. A. Norman, 1978, D. E. Rumelhart, D. A. Norman, 1978.


Mode of Learning
Content of Learning: Second Language Learning (Vocabulary)
Technology of Learning: Hypermedia
Characteristics
Characteristics
Accretion
Learning
-definition
-pronunciation
-parts of speech
-synonyms/antonyms
- relationship with other words
-sentence
Learning bits and pieces
Presentation /Representation capabilities
Present expert's knowledge /learner-characteristics tailored-model through nodes, links and semantic networks
Restructuring
Learning in context
Learning to use words appropriately in similar or different contexts
Bits and pieces brought together in context to make more sense
Construction capability
Create and reorganize links, create one's own knowledge structure or learning model through links, dynamic learner control and semantic networks
Tuning
Continuous practice to build up a language feel
The appropriate use of words become automatic
(Transfer knowledge of using a word from one situation to other situations)
Collaborating /Sharing capability
Make one's knowledge structure more accurate, efficient through sharing on a network
Levels of Processing
Time
Deeper
More